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EXHIBIT C

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

United States Patent Application

Application Number..................... 09/636157
Confirmation Number............................6508
Filing Date ............................... 08-Aug-2000
Applicant(s)................ Anil Vasudeo Virkar, Jan-Fong Jue, Kuan-Zong Fung
Group Art Unit.......................................1755
Examiner.......................Michael Marcheschi
Attorney's Docket Number.......... MS2034-1
Title......... "ALKALI-METAL-BETA- AND BETA"-ALUMINA AND GALLATE POLYCRYSTALLINE CERAMICS AND FABRICATION BY A VAPOR PHASE METHOD"

## DECLARATION OF DINESH SHETTY

I, DINESH SHETTY hereby declare as follows:

1. I have been employed at the University of Utah in the Material Science Department, in Salt Lake City, Utah and currently hold the position of Professor. My current research interests include the processing and characterization of advanced ceramic and ceramic-matrix composites.

2. I am currently President of Materials and Systems Research, Inc., assignee of the above-identified application, a position I have held since 1990. Materials and Systems Research, Inc. is specialized in ceramic materials, including ceramic electrolytic materials.

3. I have a PhD Degree from Northwester University, which was received in 1973.

4. I consider myself to have better than ordinary skill in the ceramic field of the type disclosed and claimed in the above-identified application.

5. I have read the above-identified application, and have also reviewed the file history of the parent application, 09/002,483, filed 01 February 1998, including the rejections of the claims made in during prosecution of the parent application.

6. In the above rejections the Examiner had alleged that claims reciting the term "oxygen-ion conducting ceramic" are indefinite because the term is unclear.

7. The term "oxygen-ion conducting" when used to describe ceramic materials is a term that is well known and clearly understood in the art. The term relates specifically to materials that have the ability to conduct oxygen-ions. As shown particularly in Exhibits A and B, this is a measurable property that is used to characterize ceramic electrolytic materials. As stated in the specification, starting on page 4, line 26, oxygen-ion conductors are well known. Further it is clear from the specification that the material required in the present invention is one in which oxygen-ions diffuse or are conducted or are transported through the phase. It is well within one of ordinary skill to discern and choose such a material. (See page 6, lines 1 to 3.)

8. In the above rejections the Examiner had alleged that claims reciting the term "stabilizer" are indefinite because the term is unclear.

9. The term "stabilizer" as used in the present application is well known and clearly defined in the art. The term "stabilizer" is used generally to describe materials that inhibit

transformation of ceramic phases to more thermodynamically stable phases. In context of stabilizing beta"-alumina to inhibit its transformation to beta-alumina, the stabilizer may be any one of several oxides which promote the stability of the beta"-alumina phase. Without the stabilizer beta"-alumina converts to beta-alumina at temperatures above the transition temperature. The mention in the present specification of specific stabilizers, MgO, $Li_2O$, and ZnO, and the known function of these material to stabilize beta"-alumina against transformation to beta alumina further communicates to one of ordinary skill that any of the stabilizers in the art with the same function are contemplated.

10. I am aware of and have reviewed the rejection of certain of the claims in the parent application over Chiku et al. Chiku et al. teaches formation of beta-alumina by exposing alpha-alumina to a vapor produced from a powder containing a sodium material, which may be a certain sodium/zirconia oxide. Contrary to the belief of the Examiner, there would be insufficient Zr component present in the vapor for Zr to become a significant part of the final sodium beta alumina ceramic.

11. The vapor pressure of zirconium oxide is much less than that of sodium oxide ($3 \times 10^{-28}$ atm. for $ZrO_2$ at 1100°K, as compared to $2 \times 10^{-7}$ at 1100°K for NaO and Na.) Accordingly, any amount of Zr vapor that would exist would be very small, and for that reason very little or none would become incorporated into a material from the vapor. To form a continuous phase the zirconia would have to exist in a significant amount, much larger than is possible in the vapor shown in the Chiku et al. patent. I would not find the present process

obvious over the Chiku et al reference, because I do not see the conditions sufficient to form a continuous phase of zirconia in a composite product.

12. I believe that there is no suggestion in Chiku et al. of a composite, as in the present invention, where both the oxygen-ion and metal-ion conducting phases are continuous to provide respective paths of conductivity through the composite. Accordingly, I believe the present invention to be patentable over the Chiku et al. et al. reference.

13. I am aware of and have reviewed the rejection of certain claims in the parent application over Ichikawa et al. Ichikawa et al. teaches a composite of beta alumina, sodium oxide, and zirconium oxide. The present invention requires the presence of continuous phases of both metal -ion conductor (such as beta-alumina) and oxygen-ion conductor (such as zirconia). There is no disclosure in Ichikawa et al. of any phase being continuous, much less both phases. Continuity of both phases requires a careful and deliberate control of the manufacturing conditions. I find no teachings in Ichikawa et al. that would suggest or disclose such a deliberate control or any other suggestion of a continuous phase.

14. The concentration of zirconium oxide in the Ichikawa et al composites is between 0.1 and 2 wt.%. The zirconium oxide is added to widen the range of sintering temperature, and in the amount stated would be insufficient to form a continuous phase of zirconium oxide. There is specific teaching against any larger amount of zirconium oxide greater that 2 wt.%, which larger amount would be required to form a continuous phase (col. 3, line 63, to col. 4, line 7).

15. A composite made according to the teachings of Ishikawa et al. would not have a continuous phase of zirconium oxide, as there is insufficient zirconium oxide present. Even accepting the high improbability that regions of a continuous phase of zirconium oxide and beta-alumina may be present, the existence of the continuity would be inadvertent. Such an instance would be highly unlikely since there is no teaching to direct one of ordinary skill to conditions and amounts that would inevitably form two continuous phases. Furthermore, a person practicing the teachings of Ichikawa et al. would fail to recognize any continuous phase, even if such should inadvertently occur, as there are no teachings that would motivate a practitioner to measure this property. Further, any advantages that may come about by both phases being continuous are totally unmentioned and are not suggested by Ishikawa et al.

16. I believe that there is no suggestion in Ichikawa et al. of a composite, as in the present invention, where both the oxygen-ion and metal-ion conducting phases are continuous to provide respective paths of conductivity through the composite. Accordingly, I believe the present invention to be patentable over the Ichikawa et al. reference.

17. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable be fine or imprisonment, or both under Section 1001 of Title 18 of the United State Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: 09 July 2001 By: Dinesh K. Shetty

Dinesh Shetty